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ABSTRACT

Research on text organization has demonstrated that reading is responsive to the number and complexity of idea units or propositions in a text, and that the capacity of children to recall information is responsive to the relative importance of the idea units. A study was undertaken to examine an extension of these propositions: namely, that reading is responsive to the reader's capacity for text recall. Subjects were 95 fourth grade students who were able to comprehend at least 70% of what they read on the Maze 5 and Maze 6 of the Guthrie-Seifert Maze Task. Reading comprehension scores were obtained from school test records. The subjects were tested individually and told that after they had read a story, they would be asked to retell it in their own words. Results showed that readers using text-entailed recall strategies gained the most insight into the meaning of text information, and that the more text erroneous information that a reader gave, the less his or her comprehension of text. Text-specific recalls were of marginal significance, while the impact of text external and text experiential recalls on reading were neglible. The findings suggest that recall ability is an important encoding strategy used by readers to gain meaning. (Author/FL)

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RECALL STRATEGIES AND READING COMPREHENSION

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ABSTRACT

Research on text organization has demonstrated that reading is responsive to the number and complexity of idea units or propositions in a text, and that the capacity of children to recall information is responsive to the relative importance of the idea units. The present paper examines an extension of these propositions; namely, that reading is responsive to the reader's capacity for text recall. Earlier research suggested that the type of recall used by the reader would give insight into the manner in which a reader obtains meaning from print. The study supported this thesis. Readers using text entailed recall strategies gained the most insight into the meaning of text information. On the other hand, the more text erroneous information that a reader gave the less the reader's comprehension of text. Text specific recalls were of marginal significance while the impact of text external and text experiential recalls on reading was negligible. The recall model proved to be a powerful predictor of reading comprehension, which suggests that recall ability is an important encoding strategy used by readers to gain meaning.

RECALL STRATEGIES AND READING COMPREHENSION

To what extent does an analysis of the unaided recall of a passage provide insight into how the reader gains meaning from print? Are some recall abilities more valuable than others? The analysis of reading recalls as a method of gaining insight into the manner in which meaning is obtained from print became widely accepted during the 1970s (Bower, 1976; Fredericksen, 1975, 1977; Kintsch, 1974; Kintsch and van Dijk, 1978; Rumelhart, 1975; Thorndyke, 1977; Tierney et al., 1978/79; van Dijk, 1977; and van Dijk and Kintsch, 1977). The extent to which various recall abilities indicate a reader's understanding of a passage has yet to be firmly established. The purpose of this paper, then, is to assess the theory that reading comprehension can be explained in terms of recall strategies or abilities.

A Theory of Reader-Text Interaction

In a reading situation, the information conveyed in a text is often a highly organized and interrelated set of statements consisting of networks of concepts and their relationships. As such, this semantic structure, or the interrelationship of the concepts of the text, represents the writer's underlying conceptual framework of the topic about which he is writing. It is up to the reader to integrate this semantic structure into his existing knowledge base in order to understand the intent of the passage.

If readers intuitively attempt to integrate the structures of text discourse into their own knowledge framework, one might ask how a reader's existing knowledge is organized so that it is possible to accomplish this task. Frame theory (Minsky, 1975) has been put forward as a tentative explanation. The notion is that one's knowledge is organized into high-level structural

units called "frames" which can be adapted to fit new experiences by changing the details of the frame. This view is rather like Piaget's idea of accommodation. Each frame consists of a network for representing situations such as visual concepts, experienced events, or the semantic content of linguistic messages. Frames contain slots, some of which are relatively fixed on the basis of the incoming information that rounds out or adds to the conceptual framework already in existence. Frames may be linked together to form systems which represent action sequences, cause-effect relationships and additions to or extensions of knowledge structures acquired through verbal or written discourse (Minsky, 1975).

It seems then that the notion of organization is central to a reader's cognitive structure; one could say that a cognitive structure is an organized set of concepts and procedures which allows interpretation of the world. That is, repeated experiences of similar events and situations generate mental structures which represent them. The mind tends to create order and structure out of incoming information. It seeks out regularities and expects to find them again in the future. These repeated experiences, through their internal representation into schemas, or schemata, (Kintsch, 1974; Mandler, 1979) lead to the phenomena of familiarity. A schema is described by Mandler (1979:7) as "a cognitive structure -- an organized body of knowledge" which is "formed on the basis of past experience with objects, scenes, or events and consists of a set of (usually unconscious) expectations about what things will look like and/or the order in which they will occur".

One can have a schema for anything with which one is familiar; from the detailed appearance of a physical object, to the rules for playing a game, to the notion that many stories have a common structure. An individual's knowledge of what constitutes a story appears to develop gradually as a result of

generalizations based on repeated experiences. Thus, one becomes familiar with the format of stories through hearing many tales in many situations. A reader's understanding of story structure then, may be thought of as an hierarchically arranged set of expectations about what will occur in a given situation; that is, a story situation. It seems from the research conducted by Mandler and Johnson (1977), Stein and Glenn (1979), and Thorndyke (1977) that readers intuitively use their set of expectations about types of elements that will be found in a story as well as the relationships between the elements to assist them in synthesizing the incoming information. Such strong expectations produce what is referred to as "top-down", or conceptually-driven processing.

The synthesizing of incoming information is also based, in part, on the limitations of working memory. Only a few items can be held in the mind at one time, so as new items come along, previously presented items must be recorded and organized into larger units or concepts if they are to be retained; that is, they must be grouped and related to what one knows as a setting, an event or an outcome. Evidence gathered by Fodor, Bever and Garrett (1974) illustrated that words are maintained in working memory in relatively unchanged form until they can be grouped into a clause. At that point, their representation becomes more abstract, and precise words are less likely to be retrieved. Since stories are a series of sentences, the necessity for recoding into concepts increases accordingly. Thus, categorizing into larger, higher order units becomes imperative since the sheer quantity of words prohibits retrospective rehearsal of lower level word units for later recall. Presumably, the longer and the more complicated the story, the greater the necessity to recode into higher and higher levels of concepts associated with the underlying structure of the story.

To the extent that stories tend to have a rather set structure, there are considerable limitations on the format that stories may take. Readers can utilize a relatively small set of story structures to direct comprehension and retrieval in a "top-down", or schema based fashion in which incoming information is interpreted in terms of already activated story structures. Johnson and Mandler (1979:15) claim that "a story may be quite new in its content, yet the set of expectations about a story structure allows the listener (reader) to assign the incoming sentences to higher level categories, which are themselves organized into still higher level structures".

In contrast, when new information cannot be predicted on the basis of one's existing knowledge of story structures, readers must engage in a "bottom-up", text based or data-driven processing in which an inductive understanding of the overall structure and meaning of the text is only gradually built up. During "bottom-up" processing, a reader must hold a larger quantity of incoming information in working memory until he can figure out how to chunk it into larger units which can then be related to existing schemata. This type of processing may be used more readily at a sentence level than at a story level. It would seem that within a single sentence there are more possibilities for a variety of grammatical structures and, therefore, the likelihood that a particular sentence structure will provide an accurate fit to incoming information is less than the likelihood that a particular story structure will provide the guideline for what can be expected to follow. In addition, the shorter length of sentences makes "bottom-up" processing more realistic in terms of the load placed on working memory.

This is not to say, however, that readers do not use "top-down" processing for sentences. Obviously, they use their syntactic and semantic knowledge of language to guide sentence processing. However, this method of arriving at meaning by

applying schemas or frames in a "top-down" fashion is likely to be more important in story processing, simply because of the increased amount of information load inherent within the continuous discourse of a story.

Schema concerning an event within a story, or a sequence of events can be very clearly defined, and as such, is referred to as a "script" by Shank and Abelson (1977). Their example of a script is the typical sequence of events that one expects to occur when going to a restaurant for a meal. Obviously, the acceptable and expected range of sequence is rather narrow and highly predictable. Shank and Abelson use the term "plan" to describe a more general event schema. Plans consist of very broad sets of expectations based on one's knowledge of the motivations and goals people have as they engage in various sequences of activities such as going on a holiday. Plans, then, are more tentative than scripts and depend on more "bottom-up" hypothesis formation, rather than "top-down" conceptualization. That is, scripts control our expectations of the sequence of events rather precisely, whereas plans constitute more of a general, continual hypothesis testing situation based on incoming data. Plans assist in organizing the incoming data but are easily modified in the light of information received later in a story.

The more the reader's comprehension is directed by "top-down" processing, the more it takes on an inferential aspect. Since it is impossible to attend to all of the details within a story, many are supplied by the reader's cognitive schema associated with the actual episode, rather than by the visual perception of all words. This inferential aspect of perception has been called "default" processing (Mandler, 1979) and it is simply the instantiation, or filling in with the most acceptable details.

Clearly, when reading, both types of processing will occur simultaneously. It would seem that when a reader encounters a

story with a definite script format which he is able to identify from the title and/or the opening sentence, "top-down" processing will dominate the reading situation. However, if the story structure is less clearly defined at the onset of the reading, the reader will have to rely, initially, more heavily on "bottom-up" processing. As he employs the use of his knowledge of a story plan, he determines approximately where the story is going and, once into the stream of the story, it is likely that a script for episodes or connected episodes will emerge. The reader will then be able to utilize more "top-down" processing and consequently engage in more instantiation.

On the one hand we have a theory that says that the reader is controlled by his stored knowledge and on the other, a theory that says the reader responds to the text and the situation. What seems likely is that readers alter their approach to processing discourse to meet the demands of the particular reading situation as well as varying demands within the reading situation. The question still remains, however, as to what extent discourse comprehension is text based and to what extent it is schema based.

Recall Analysis

It would seem, then, that readers selectively process text using information both from the text and from their knowledge of the world in order to construct an interpretation based upon the integration of the two sources of information. Such a view of what readers are doing as they comprehend is clearly in the forefront of current reading theories.

A recently developed procedure for attempting to assess the extent of text based and schema based processing is recall analysis. To utilize this technique, subjects are asked to read a passage, whose semantic structure has been identified, and then

have them recall the content of what they have read. In several such studies, it has been found that readers typically recall only part of the message conveyed in the passage (Crothers, 1972; Frederiksen, 1975a, 1975b; Meyer, 1974). Furthermore, the information they do recall is not a random selection of individual bits of the content; rather it consists of an organized and highly structured series of informational items from the text. That is, items are not recalled independently, but in clusters that are mutually dependent and that correspond to units of semantic information such as concepts, states or events.

Apparently, then, the ability to understand a text involves the ability to analyze that text into interrelated semantic units which can then be assimilated into one's already existing knowledge structure and, thereby, stored for later retrieval. Such semantic processing of units occurs at different levels; some units may be as small as single concepts, states or events and others as large as substantial portions of a text's content which might include an entire episode within a story. Kintsch and van Dijk (1978:363) have been as explicit as any of the discourse processing or recall strategy theorists in their specification of the mental operations which underlie the processing of text and the subsequent production of the recall of a text. They claim that three sets of operations are involved.

> First, the meaning elements of a text become organized into a coherent whole, a process that results in multiple processing of some elements and, hence, in differential retention. A second set of operations condenses the full meaning of the text into its gist. These processes are complemented by a third set of operations that generate new texts from the memorial consequences of the comprehension processes.

How, then, does the researcher interpret the reader's meaning? Most analysts assess meaning in terms of the degree to which the reader's meaning and the author's meaning correspond.

Tierney and Bridge (1979), among others, claim that by analyzing a passage and comparing a subject's verbal recall of the text to the structure of the passage itself, the nature of a reader's organizing procedures can be assessed. The assumption is that the way the child subconsciously selects and organizes information as he reads the passage will be portrayed in the way he organizes and presents the gist of that passage in an unaided recall situation. A study of the kind of information that a child uses in his recall should shed light on what information he is selecting from the passage, how he is relating that information to prior knowledge in order to understand the passage, and how he is structuring the information into a summary of the content of the passage.

Recall information gathered in this study was divided into five categories: (i) text specific information which included verbatim information, or in paraphrase form, information from a single utterance of the original; (ii) text entailed information in which the information retrieved was a paraphrase from more than one unit of text, a summary or a correct inference; (iii) text experiential information which was somewhat related to the text but embellished by the reader on the basis of prior knowledge; (iv) text erroneous information which involved using text information which the reader had confused or combined in an erroneous way; and (v) text external information which included vague generalizations or story telling conventions. Descriptions of these classifications which are basically those of Drum and Lantaff (1978), but with slight modifications, are given in the Appendix. The recall analysis conducted here was begun by dividing the text into basic units; that is, clauses. The reader's recalls were then divided into clausal units and a comparison was made between the two by allocating the recall

units into one of the five categories. The categories represented the amount of text as compared to the amount of background knowledge that the reader used. They indicated, therefore, the extent of the script or text based processing engaged in by the reader.

Text specific responses, for example, are largely text bound since they involve identical phrasing from the text or a lexical paraphrase. In this sense they reflect an abstractive processing which is necessary but certainly not sufficient for complete meaning. Text entailed responses involve the interaction of text and a reader's prior knowledge, and in this sense reflect constructive processing. Text experiential responses indicate greater reliance on prior knowledge than the text. Text external responses are different from the others in that they have little to do with knowledge of the text itself. They are story telling conventions at best, but often merely represent vague generalizations. Text erroneous responses involve either incorrect processing of text or inappropriate use of background knowledge.

One may infer from the recall categories what processes are involved in obtaining meaning. Recalls in the text specific category result from memory reproduction and transformation processes which provide for lexical substitution. Text entailed information is produced through a reconstruction process or by transformation involving explication of text relationships. The experiential category is less constrained by text information and more dependent on world knowledge than text entailed information. Text external responses are probably only minimally related to text since for the most part they seem to be conventions for dealing with information that has not been adequately stored or which cannot be retrieved. Finally, the erroneous category would indicate that some of the processes described have broken down during recall.

On the basis of the above discussion of recall analysis the following hypotheses were formulated:

(i) that text specific, text entailed and text experiential recalls will be positively related to reading comprehension; but

(ii) because text entailed recalls reflect both abstractive and reconstructive processes they are likely to be more closely related to reading comprehension than either text specific or text experiential recalls;

(iii) that text erroneous recalls will be negatively related to reading comprehension; while

(iv) text external recalls will have little relationship to reading.

Method

Sample and Materials

Ninety-five grade four pupils from two urban schools constituted the case base for the study. It was decided that all subjects would be asked to read the same passage; thus, only subjects able to comprehend at least seventy percent of what they read on the Maze 5 and Maze 6 of the Guthrie-Siefert Maze Task (n.d.) were selected. Seventy-four percent of the grade four children were selected -- forty-seven boys and forty-eight girls.

The passage selected was from the Goodman and Burke (1972) Reading Miscue Inventory entitled "Space Pet". The passage had been found suitable in previous research (Beebe, 1976). The passage selected contained seven hundred and forty-one words; hence, was significantly longer than the passages used by researchers for recall analysis. It was, however, about the length of the stories found in grade four basal readers; therefore, representative of the stories read by the children in their classroom setting.

The children were tested individually and told that after they had read the story aloud, they would be asked to retell the story in their own words. Immediately following the reading each child retold as much of the story as he could remember.

The Guthrie-Siefert Maze Task is a modification of the cloze procedure. Instead of a word in a blank, the reader must select one of three alternative words that are embedded for every fifth word in the story. The percentage of correct selections indicates the degree of comprehension for that passage. The instrument consists of seven passages graded from primer to 5.1 in difficulty. Maze 5 corresponds to a grade 4.5 level and Maze 6 to a grade 5.2 level. Each test has twenty-eight items, hence, the total possible score for any child was 56. The cut-off point for inclusion in the sample was forty points out of fifty-six, which meant that the students were comprehending at least seventy percent of what they read. Guthrie (1973) describes the reliability and validity of the instrument and demonstrates that it correlates 0.82 with the Gates-MacGinitie Comprehension Subtest.

The reading comprehension measure was a grade equivalent score from the administration of the Canadian Tests of Basic Skills (CTBS) (King and Hieronymus, 1974). Since the school year is some ten school months in length the mean reading score of 51.2 reported in Table 1 may be interpreted as follows: that the average student was reading at the grade 5.12 level which in terms of Canadian norms is the equivalent of 51.2 months of schooling. Reading test selections varied in length from a few sentences to a full page. Each passage was followed by multiple choice questions designed to evaluate the student's grasp of the author's meaning; in particular the ability to evaluate the ideas presented and to draw accurate conclusions. Students were required to answer sixty-eight items in fifty-five minutes. King and Hieronymus (1975) report a split half reliability of 0.92 for

the reading comprehension subtest. The CTBS was administered by the local school authority as part of a Province-wide testing program only a few days following the completion of the audio taping stage of the research.

Procedure

At step one of the data gathering procedure the subjects read the selected passage and retold the story in their own words. The entire procedure was audio taped. The second step involved replaying the tape in order to transcribe student recalls. In the third stage, the transcribed protocols were divided into clausal units and mazes. Maze units consist of false starts, repetitions and corrections or voiced pauses (um, uh and ah). They are believed to be stalling tactics which speakers use in order to provide time for mentally organizing the information to be communicated (Fagan, 1978). Mazes were not considered part of the information a child recalled; and, therefore, were not used in the analysis phase of the project as predictors of reading. The inter-rater agreement between two of the authors for dividing recalls into clausal units was 93.4 percent across six ratings. The Arrington reliability formula (Fiefel and Lorge, 1950) was used for estimating inter-rater agreement.

The fourth step consisted of comparing the clausal units to those of the original passage followed by the allotment of each unit into one of the five recall categories described in detail in the Appendix. The inter-rater reliability score for this categorization was 93.7 percent across six ratings. For analysis purposes the scores for each category of recall were converted into percentages as follows. The number of recalls in each category was divided by a constant and the resulting proportion multiplied by one hundred. The constant selected was the total number of recalls across all five recall categories given by the student with the highest number of recall units. This constant

was fifty-nine. Suppose, for example, an individual gave ten text entailed recalls; that individual's score would be (10/59) x 100 = 17 percent. If the same individual gave five erroneous recalls his text erroneous score would be (5/59) x 100 = 8.5 percent. Descriptive statistics for the variables used in the subsequent analyses are presented in Table 1.

Insert Table 1 about here

At the data coding stage of the research two important decisions were made. First, it was found that grade four students gave virtually no recalls which could be classified as text experiential. This recall category was dropped from further consideration. Second, the question of whether to use the data in the text external category arose. Text external recalls were of two kinds: vague generalizations and story conventions. Most text external responses fell into the story convention classification. They included expressions such as "I can't remember any more", "I forget what else is said", and "and that", "or something", and "at the end it said". This kind of information is not representative of anything abstracted from the text for construction into meaning. Rather, it seemed to indicate that the child knew there was more information in the story but was unable to recall the information or to show how it related to the information which had been processed during the reading of the passage. Nevertheless, it was decided to proceed by including the text external category in the model but to hypothesize that this information would be unrelated to reading comprehension. See hypothesis (iv) above.

Results

The matrix of correlations between the variables and their levels of statistical significance are presented in Table 2. As hypothesized, text specific and text entailed recalls are positively related to reading. The amount of erroneous information given was negatively related to reading. These results were all statistically significant. The relationship between text external information and reading, as hypothesized, was not significant.

Insert Table 2 about here

The results of an ordinary least squares (OLS) regression analysis are presented in Table 3. These are interesting on two grounds. First, when taking into account the effects of text entailed and text erroneous information the impact of text specific information on reading comprehension is negligible. Because the effect of text external information was also negligible most of the variance in reading comprehension in the recall strategies model was accounted for by text entailed and text erroneous strategies of recall respectively.

The second interesting finding concerns the magnitude of the standardized beta coefficients for the text entailed and text erroneous parameters. Both coefficients are larger than the simple correlation values for the same relationships. This finding suggests that the OLS estimates are inflated; hence, untrustworthy.

Insert Table 3 about here

Beta coefficients larger than the underlying correlation coefficients are uncommon, but consistent with two possibilities.

The first is that the apparently inflated estimates are attributable to the problem of multicollinearity. The second possibility is that suppressor effects are operating. The first condition is commonplace in the social sciences. The second is an example of a type of confounding effect. Confounding variables are also ubiquitous in social science research (Kish, 1975), but confounding in the guise of a suppression effect is rare. Logically, it makes most sense to examine the data set in order to discern the presence or absence of multicollinearity before looking for suppression effects.

Multicollinearity denotes the existence of substantial correlations among the independent variables of a model. Its effect is to invalidate some of the basic assumptions underlying the mathematical estimation of simultaneous equations. For example, it produces large standard errors so that the estimates of the true model parameters become unstable. The parameter estimates will fluctuate from sample to sample, and often drastic changes in the estimates will occur after only minor data revision. All too often, then, conflicting conclusions will be reached from the usual tests of significance. There are numerous studies which verify these statements (for example, Blalock, 1963, 1964; Christ, 1966; Farrar and Glauber, 1967).

Recently a technique known as ridge regression (RR) has been used to cope with the multicollinearity problem. RR involves the introduction of a modest amount of bias into an equation in an effort to reduce the harmful effects of the variance inflation which usually accompanies attempts to analyze nonorthogonal data. Vinod (1978) in a review paper, notes that Monte Carlo simulation experiments have demonstrated the superior properties of RR for coping with collinearity-prone data compared to OLS regression. Unfortunately, RR is not a single technique but rather a family of methods, each of which will generate different parameter estimates, and no single method is guaranteed to give the best

set of estimates under all conditions. In Table 4 four different RR methods are used to estimate the parameters of the recall strategies model of reading. The results of each method may be compared to those of other RR methods and to those of the OLS analysis.

Insert Table 4 about here

The most noteworthy finding from the RR analysis is that the beta estimates differ very little from one RR technique to another. The ridge estimates differ considerably, however, from the least squares estimate. In Table 4 the "k" refers to the biasing parameter introduced by each RR method. Note that in each case the bias introduced is less than 0.15; that is, very small. Dmax in Table 4 refers to the degree of multicollinearity. On a scale from 0 to 1, Dmax = 0 represents no collinearity while Dmax = 1 represents perfect collinearity. Dmax = 0.5 indicates that the variance inflation of the estimated betas is over twice as high as it should be if the data set were orthogonal. Though Dmax = 0.5 is undesirable it is not to be regarded as excessive; and Dmax = .570 for the OLS analysis cannot be considered excessive either. Note that each RR procedure reduces the Dmax ratio closer to zero and that the modestly inflated OLS coefficients are reduced in magnitude accordingly, as is the R-square goodness of fit value. Explanations for the effects of reducing multicollinearity in systems of equations may be found in Bulcock et al. (1981) and Bulcock and Lee (1983).

One may conclude from the results of the RR analyses that the standardized OLS coefficient of 0.437 for the effect of text entailed information on reading is inflated; thus, the finding that this OLS coefficient is larger than the underlying correlation coefficient is spurious. Even so, the RR analysis

while reducing the magnitude of the OLS effect of text erroneous information on reading did not reduce it to a level below the magnitude of the zero-order relationship (r_{3y} = -.226). We conclude, therefore, that the text specific and the text entailed variables are operating as suppressor variables; that is, are suppressing the true effect of the text erroneous information on reading comprehension. This conclusion requires further elaboration.

A suppressor variable is one which when controlled strengthens a previously suppressed association between an independent variable of interest and the dependent variable. In the present case text erroneous recall information (TERR) is the variable of interest and the suppressor variables are the text specific (TSPEC) and text entailed (TENT) variables. The suppression occurs because TSPEC and TENT when uncontrolled dilute the association between TERR and reading. The suppressors which are positively related to TERR are not relevant to the relationship of interest; but nevertheless manage to reduce the true relationship. In effect only a small portion of the TERR variable is being allowed to affect reading.

In the present instance TERR correlates modestly with reading (r = -.226). But when the TSPEC and TENT suppressor variables are controlled a much stronger negative relationship between TERR and reading is revealed. The suppressed portion of TERR that is related to reading alone is allowed to contribute to the association of interest when statistical controls are imposed; and this permits the true relationship between TERR and reading to emerge. Controlling the suppressor variables results in the refinement of the TERR variable, which as a result strengthens its association with reading.

The four RR analyses generated different estimates, but these were so similar to one another that each set of results virtually confirmed the authenticity of the other three sets. On the other

hand, the RR analyses differed appreciably from the OLS analysis. As a result of the difference between RR and OLS analyses it was concluded that the OLS estimate of the relationship between TENT and reading (beta = .437) was artifactually high due to the presence of multicollinearity. Even so, the multicollinearity problem for the data set as a whole was not considered problematic. In general terms erroneous conclusions would not have been drawn from the OLS estimates.

As a result of the RR analyses, it was also concluded that the relationship between TERR and reading (OLS beta = -.372 compared to a simple correlation of -0.226) was not spuriously high due to multicollinearity. Rather, this unexpectedly powerful relationship was revealed because TSPEC and TENT operated as suppressor variables; hence, masked the true relationship between TERR and reading comprehension. Both the RR and OLS results support the recall strategy theory of reading even though there were noticeable differences in the magnitude of the estimates generated by the two different estimating techniques.

Discussion

In general the results demonstrated the predictive validity of the recall strategy model of reading comprehension. Two strategies in particular were significant and powerful predictors of the reading comprehension scores on a standardized test. The more text entailed information in a child's recall, the higher the comprehension score; and the more text erroneous information, the lower the score. The text specific strategy was not important in and of itself when the effects of text entailed and text erroneous information were taken into account; rather, its importance stemmed from its relationship to reading via text entailed information. That is, text specific information

influences comprehension because this is what is abstracted from a passage, integrated into the reader's cognitive structure, and as such becomes part of what is reconstructed and retold as largely text entailed information. The text experiential category was eliminated as a model component of grade four reading because few responses fell into this category. Conceptually the text experiential category seemed to involve similar processes to the text entailed category.

In terms of the present analysis, recall categories provide a useful basis for making inferences about what strategies readers use for gaining meaning while reading. These inferences largely involve the processes used in the interaction between text information and the reader's prior knowledge. The effect of text entailed information on reading comprehension confirmed the importance of the processes labelled by Tierney et al. (1978) as abstractive and constructive. That is, readers attempt to: (I) "glean ... relevant units from the text; and (II) summarize the ideas into a manageable form in accordance with what can be handled by the memory system ..." (Tierney et al., 1978:554). This seems to involve the reader in using background knowledge to either synthesize units of information in the text or to make inferences which are constrained by text information. The results of the regression analysis were consistent with this conclusion; namely, that the role of text information lies not in how much specific information can be abstracted but in what the reader does with the information that he does abstract. Abstractive processes, then, were found to be necessary but not sufficient for reading comprehension to occur. It was when the reader was able to relate background knowledge to text information that comprehension was high. And when constructive processes broke down, erroneous information tended to be generated which negatively affected comprehension.

The method of recall analysis used in this research could prove useful to researchers, clinicians and teachers for two reasons: it is easy to administer, and it has demonstrable predictive validity. Because this type of recall analysis can be used to analyze both narrative and informational passages of varying length, it is more flexible than most methods. The insights gained through its use could help educators to determine an appropriate balance between comprehension tasks involving factual recall and those which encourage children to use their background knowledge to engage in constructive processes as they read.

REFERENCES

Beebe, M.J. Case Studies of grade level effects on children's miscues and reading comprehension. Canadian Journal of Education, 1976, 1, 51-62.

Blalock, H.M. Correlated independent variables: the problem of multicollinearity. Social Forces, 1963, 42, 233-237.

Blalock, H.M. Causal inferences in non-experimental research. Chapel Hill: University of North Carolina Press, 1964.

Bower, G.H. Experiments on story understanding and recall. Quarterly Journal of Experimental Psychology, 1976, 28, 511-534.

Bulcock, J.W. and Lee, W.F. Normalization ridge regression in practice. Sociological Methods and Research, 1983, 11, 3, 259-303.

Bulcock, J.W., Lee, W.F. and Luk, W.S. The theory of normalization ridge regression. ED 178 581. Washington, D.C.: National Institute of Education, Educational Resources Information Center, 1981.

Christ, C.F. Econometric models and methods. New York: John Wiley, 1966.

Crothers, E.J. Memory structure and the recall of discourse. In R. Freedle and J.B. Carroll (eds.), Language Comprehension and the Acquisition of Knowledge. Washington, D.C.: Winston, 1972, pp. 247-284.

Drum, P.A. and Lantaff, R.E. Prose recall responses and categories for scoring. In P.D. Pearson and J. Hanson (eds.), Disciplined Inquiry in Process and Practice. Twenty-seventh yearbook of The National Reading Conference. Clemson, S.C.: The National Reading Conference, 1978.

Fagan, W.J. A Comparison of the Oral Language of Children Age Nine, Ten and Eleven. A research report. Canada Council grant 576-0563. Department of Elementary Education, University of Alberta, Edmonton, 1978.

Farrar, D.W. and Glauber, R.R. Multicollinearity in regression analysis: the problem revisited. Review of Economics and Statistics, 1967, 49, 92-107.

Fiefel, H. and Lorge, I. Qualitative differences in the vocabulary responses of children. Journal of Educational Psychology, 1950, 41, 1-18.

Fodor, J.A., Bever, T.C. and Garrett, M.F. The Psychology of Language: An Introduction to Psycholinguistics and Generative Grammar. New York: McGraw-Hill, 1974.

Fredericksen, C.H. Acquisition of semantic information from discourse: Effects of repeated exposures. Journal of Verbal Learning and Verbal Behavior, 1975a, 14, 158-169.

Fredericksen, C.H. Effects of context-induced processing operations on semantic information acquired from discourse. Cognitive Psychology, 1975b, 7, 139-166.

Fredericksen, C.H. Semantic processing units in understanding text. In R.O. Freedle (ed.), Discourse production and comprehension, Vol. 1. Norwood, N.J.: Ablex Publishing, 1977, 55-87.

Goodman, Y.M. and Burke, C.L. Reading Miscue Inventory. New York: MacMillan, 1972.

Guthrie, J.T. Reading comprehension and syntactic responses in good and poor readers. Journal of Educational Psychology, 1973, 65, 294-299.

Hoerl, A.E., Kennard, R.W. and Baldwin, K.F. Ridge regression: some simulation. Communication in Statistics, 1975, 4, 2, 105-123.

Johnson, N.S. and Mandler, J.M. A tale of two structures: Underlying and surface forms in stories. Poetics, 1979.

Kasarda, J.D. and Shih, W.F. Optimal bias in ridge regression approaches to multicollinearity. Sociological Methods and Research, 1977, 5, 461-470.

King, E.M. and Hieronymus, A.N. Canadian Tests of Basic Skills. Toronto: Thomas Nelson, 1974.

King, E.M. and Hieronymus, A.N. (eds.), Canadian Tests of Basic Skills: Manual for Administrators, Supervisors and Counsellors. Toronto: Thomas Nelson, 1975.

Kintsch, W. The Representation of Meaning in Memory. Hillsdale, N.J.: Lawrence Erlbaum Associates, 1974.

Kintsch, W. and van Dijk, T.A. Toward a model of text comprehension and production. Psychological Review, 1978, 85, 363-394.

Kish, L. Representation, randomization and control. In H.M. Blalock Jr., et al. Mathematical Models and International Perspectives on Mathematical Sociology. New York: Academic Press, 1975.

Lawless, J.F. and Wang, P. A simulation study of ridge and other regression estimators. Communications in Statistics, 1976, A5, 4, 306-323.

Mandler, J. Categorial and schematic organization in memory. In C.R. Puff (ed.), Memory Organization and Structure. New York: Academic Press, 1979.

Mandler, J.M. and Johnson, N.S. Remembrance of things past: story structure and recall. Cognitive Psychology, 1977, 9, 111-151.

Meyer, B. The organization of prose and its effect on recall. Report No. 1, Reading and Learning Series, Ithica, New York: Cornell University, Department of Education, 1974.

Minsky, M. A framework for the representation of knowledge. In P. Winston (ed.), The Psychology of Computer Vision. New York: McGraw-Hill, 1975.

Rumelhart, D.E. Notes on a schema for stories. In Bobrow, D.E. and Collins, A. (eds.), Representation and Understanding. New York: Academic Press, 1975, 211-236.

Shank, R.C. and Abelson, R.P. Scripts, Plans, Goals and Understanding. Hillsdale, N.J.: Erlbaum, 1977.

Stein, N.L. and Glenn, C.G. An analysis of story comprehension in elementary school children. In R. Freedle (ed.), New Directions in Discourse Processing. Norwood, N.J.: Ablex, 1979.

Thorndyke, P.W. Cognitive structures in comprehension and memory or narrative discourse. Cognitive Psychology, 1977, 9, 77-110.

Tierney, R.J. and Bridge, C.A. The functions of inferences: An extended examination of discourse analysis. In M.L. Kamil and A.J. Moe (eds.), Reading Research Studies and Applications. Clemsen, S.C.: The National Reading Conference, 1979, 129-133.

Tierney, R.J., Bridge, C. and Cera, M.J. The discourse processing operations of children. Reading Research Quarterly, 1978, 14, 537-569.

van Dijk, T.A. Semantic macro-structures and knowledge frames in discourse comprehension. In M.A. Just and P.A. Carpenter (eds.), Cognitive Processes in Comprehension. Hillsdale, N.J.: Lawrence Erlbaum, 1977, 3-32.

van Dijk, T.A. and Kintsch, W. Cognitive psychology and discourse. In W.U. Dressler (ed.), Trends in text linguistics. New York: DeGruyter, 1977.

Vinod, H.D. A survey of ridge regression and related techniques. Review of Economics and Statistics, 1978, 60, 121-131.

TEST REFERENCES

Canadian Tests of Basic Skills. E.M. King and A.N. Hieronymus, 1974.

Maze Task: Experimental Version. J.T. Guthrie and M. Seifert, n.d.

APPENDIX

COMPREHENSION CATEGORIES FOR PROTOCOL ANALYSIS

The initial division is made on the basis of syntactic criteria; each unit is then analyzed into its semantic content and assigned to one of the following categories. Note that the recall strategies described here are based on those of Drum and Lantaff (1978). They have been modified in order to minimize coding ambiguity.

A. TEXT SPECIFIC

This category includes verbatim information or information in paraphrase form that has been retreived from a single utterance in the original text.

A1. Verbatim Recall

Text: People were waiting at the door.

Protocol: People were waiting by the door.

A2. Substitution of Pronouns

A pronoun is used in place of a noun when the noun referent is present elsewhere within the text. All other items in the units are verbatim.

Text: People were very kind to the stranger.

Protocol: They were very kind to the stranger.

A3. Synonymy of Elements

The operational definition of synonymy is context dependent and may refer to (a) substitution of one word for another so that semantic and grammatical features are preserved, (b) the sequencing of lexical items from a unit such as the reordering of prepositional phrases or substituting an active for a passive, and (c) a paraphrase of the original unit which in the subjective

opinion of the scorer has the same conceptual referents and has definite correlates in the text unit.

Text: The house was on fire.

Protocol: The house was burning.

A4. Partial Recall

A significant concept(s) (noun, verb, attribute) is/are omitted in the recall.

Text: After robbing the store, the convicts raced for their car.

Protocol: The convicts raced for their car.

B. TEXT ENTAILED

The information retrieved is (a) a paraphrase of or synonymous with the information input, but the unit of recall includes information from more than one unit of input (b) a superordinate statement subsuming information from more than one text unit, or (c) an inference.

B1. Summary

A summary statement is (1) a compilation of at least two units of information. It may not contain either of the specific units summarized but may be expressed in a hierarchical or superordinate category or by a label generalizing the events summarized.

Text: While visiting her Aunt Lizzie at the farm last weekend, Teri helped harvest some carrots, peas, zucchini and tomatoes.

Protocol: Last weekend, Teri helped her Aunt harvest some vegetables.

B2. Synthesis

A statement is a synthesis if it relates information from at least two units in the text in an embedded form; that is, some of the lexical items or units of information are deleted during this process.

Text: She jumped into the icy water. She was trying to save the swimmer who was in trouble.

Protocol: She jumped into the icy water to save the swimmer in trouble.

B3. Inference

An inference may include either a logical reasoning or an instantiation, that is, the filling in of information suggested by the text information but not specified. The latter is often referred to as a pragmatic inference and may be stated in a contradictory form and still make a plausible statement.

Text: John and Bill left for school at the same time and walked at the same rate. But Bill lived several blocks farther away from the school than John. John just reached the school on time. He hoped that Bill would still be able to play ball that evening.

Protocol: (Logical): Bill was late for school.

Text: The mother bundled the children in the parkas, scarves and mittens. She was sure they all had a hot lunch as they left for school.

Protocol: (Pragmatic): It was a cold day.

(Contradiction: It was not a cold day. Perhaps the mother was mentally deranged.)

C. TEXT EXPERIENTIAL

This information is added by the reader either on the basis of his having experiences related to the theme of the text passage or from his knowledge of the world and stories so that the insertion is a plausible continuance of the story line.

C1. This information is related to the theme of the text passage but is not specifically suggested by a particular unit in the text. It does not convey the text information but is an addition of information from the reader's background.

Text: The little boy had disobeyed his mother. She had told him to wait by the car while she went back to the store for the other bag of groceries. Now she could not find him anywhere.

Protocol: One time I saw this woman looking for her little boy. He went up the escalator when she wasn't looking.

C2. Storyline additions

These units include additions to the information within the storyline. The origin of these additions appears to be based on the reader's experience with stories and the kinds of goals or actions which are appropriate in a particular context. Also included are expressions that indicate saying, thinking, etc. which are not specifically stated in the text.

Text: The stranger saw that the man was weak and finally dug a hole through the ice for him.

Protocol: The man said "I am not able to dig the hole." But the stranger said "You got to keep trying." The man said "I just can't do it."

D. TEXT ERRONEOUS

The protocol units involve the use of text information which the reader has confused or which he has combined in an erroneous way.

D1. Errors in dates and proper names

These errors constitute memory errors or are due to lack of attention to the text. The appropriate slot is there but is inaccurately filled.

Text: Sir Wilfred Laurier.

Protocol: Sir Wilfred Bennett.

D2. Erroneous expansions/additions

These units (I) separate attribute/argument phrases into units that are conceptually wrong, (II) expand a unit of information in an erroneous way (B), or add information that is incorrect in terms of world knowledge of the events mentioned, or is contradictory with information in the text. These may be due to lack of experience with the content and/or the ambiguity of the text.

Text: They ground corn.

Protocol: They ground corn by heating it.

D3. Inaccurate/incorrect summary

Information from different units of the text is (I) designed by an inaccurate superordinate referent, or (II) is generalized in a way which does not convey the gist of the passage.

Text: While visiting her Aunt Lizzie at the farm last weekend, Teri helped harvest some carrots, peas, zucchini, and tomatoes.

Protocol: Last weekend Teri helped her Aunt harvest some fruit.

D4. Inaccurate/Incorrect synthesis

In combining information the reader confuses information about a particular referent.

Text: The dogs lay down and refused to move. The man dragged the sled all the way to the cabin.

Protocol: The dogs dragged the sled to the cabin.

D5. Faulty Inference

The reader draws an incorrect inference from the information given in the text.

Text: Mrs. Gray knew it was two o'clock because she could hear Henry, her parrot squawking. He wanted to watch his favourite TV program. But Mrs. Gray thought that too much TV was bad for Henry's eyes so she told him to rest instead. He squawked even louder so she finally turned on the TV set. After Henry's show was over, she stayed to watch a show on cooking.

Protocol: Mrs. Gray came in from the garden to watch her TV show.

E. TEXT EXTERNAL

Protocol units (a) usually include elements of the text but they are embedded in other information that is so general that it does not convey any specific information, or (b) have no specific relationship to the text and occur as conventions of oral recall.

E1. Vague Generalizations

These either have no specific referent in the text and though not inaccurate are vague; or a vague term is used in referring to concepts from the text.

Text: (describing the manufacture of various items of clothing)

Protocol: They make dresses and stuff like that.

E2. Story Telling Conventions

These are statements that relate to the conventions of telling a story and are concerned with the narrating rather than with the content.

Text: (no specific referents)

Protocol: "Well it says that ..."

"And in the second paragraph the story says ..."

"That's all I can remember."

Table 1

Descriptive Statistics for Variables in the Recall Strategies Model

Variables	$\bar{X}$	SD	Range	Low Score	High Score	Skew-ness	Kurt-osis	N
Text Specific	5.537	10.786	99	0.0	99	7.162	61.01	95
Text Entailed	9.653	10.816	98	1.0	99	6.135	49.68	95
Text Erroneous	3.937	10.164	99	0.0	99	8.890	83.67	95
Text External	2.695	10.155	99	0.0	99	9.267	88.62	95
Reading Comp.	51.158	18.618	72	27.0	99	1.619	2.11	95

Table 2

Correlation Matrix of Variables in the Recall Strategies Model[a]

Variable	X_1	X_2	X_3	X_4	Y
	1.0000				
X_1 Text Specific					
	.7140	1.0000			
X_2 Text Entailed	(.0001)				
	.3032	.2686	1.0000		
X_3 Text Erroneous	(.001)	(.004)			
	.4583	.3873	.2662	1.0000	
X_4 Text External	(.0001)	(.0001)	(.005)		
	.2712	.3913	-0.2262	.1429	1.0000
Y Reading Comp.	(.006)	(.0001)	(.019)	(.097)	

[a]The level of statistical significance (p) is reported in parentheses below the correlation coefficient.

Table 3

Ordinary Least Squares Regression Results[a]

Independent Variables	Dependent Variable Y - Reading Comprehension Regression Coefficient	Standardized Coefficient	t-value
X_1 Text Specific	.056 (.162)	.049 (r=.271)	.342
X_2 Text Entailed	.418 (.132)	.437 (r=.391)	3.170
X_3 Text Erroneous	-.803 (.220)	-.372 (r=-.226)	3.650
X_4 Text External	.146 (.317)	.050 (r=.143)	.459
Constant	42.51		
R-Square	.276		
Dmax	.570		

[a] Standard errors are presented in parentheses below the partial regression coefficients. Zero-order relationships are presented in parentheses below the standardized coefficients. T-values GT 2.0 are significant at the $p \leq .05$ level.

Table 4

Regression Coefficients, Standardized Regression Coefficients, t-value, Degree of Multicollinearity, Biasing Constant and R-Square Goodness of Fit for Recall Strategy Model (N=95)[a]

Estimating Method	Text Specific Beta Coeff	Text Specific Stand Coeff	Text Entailed Beta Coeff	Text Entailed Stand Coeff	Text Erroneous Beta Coeff	Text Erroneous Stand Coeff
1. OLS	.056 (.162)	.049	.418 (3.170)	.437	-.803 (3.650)	-.372
2. Bulcock & Lee 1983	.095 (.819)	.084	.337 (3.531)	.352	-.684 (3.620)	-.317
3. Kasarda & Shih 1977	.093 (.781)	.082	.343 (3.506)	.358	-.693 (3.625)	-.321
4. Hoerl, Kennard & Baldwin 1975	.090 (.745)	.080	.348 (3.481)	.364	-.701 (3.630)	-.325
5. Lawless & Wang 1976	.094 (.817)	.083	.338 (3.530)	.353	-.684 (3.621)	-.317

[a] T-values are presented in parentheses below the beta coefficients.

Table 4 (continued)

Estimating Method	Text External Beta Coeff	Stand Coeff	Dmax	k-value	R^2
1. OLS	.146 (.459)	.050	.570	0	.276
2. Bulcock & Lee 1983	.133 (.509)	.046	.092	.132	.208
3. Kasarda & Shih 1977	.136 (.504)	.047	.128	.120	.213
4. Hoerl, Kennard & Baldwin 1975	.136 (.500)	.047	.165	.108	.218
5. Lawless & Wang 1976	.133 (.509)	.046	.093	.131	.208